FOREST PRODUCTS
Project Fact Sheet

CONTROL OF SOLUBLE SCALE FOULING IN HIGH SOLIDS BLACK LIQUOR CONCENTRATORS

BENEFITS

- Develops fundamental information on characteristics of Na_2CO_3 and Na_2SO_4 in black liquor solids
- Minimizes fouling of concentrators
- Improves design and operation of existing and future high solids concentrators
- Offers a model for evaluating design and operational changes
- Provides a monograph to guide improvements in black liquor evaporators

APPLICATIONS

The entire pulp and paper industry will benefit from information on controlling soluble scale fouling in black liquor concentrators.

Study Will Increase Knowledge of the Solubility of Sodium Salts in High Solids Black Liquor

Two salts, sodium carbonate (Na_2CO_3) and sodium sulfate (Na_2SO_4), present a major fouling problem in falling film concentrators, the most common technology for producing black liquor with a high solids content. These salts readily form soluble scales and may require a shut down of boilers for a boil-out every four to six days. Before this fouling can be controlled, operators need a better understanding of the complex solutions in which these salts occur and the variables that affect the crystallization process in black liquor concentrators.

The pulp and paper industry and its suppliers will use the information derived from this research to make improvements in the design and operation of present and future high solids concentrators. These changes will help minimize fouling from Na_2CO_3 and Na_2SO_4 and improve the performance of black liquor evaporators. This will ultimately improve the efficiency of the chemical recovery process in pulp mills.

Figure 1. Photograph of a black liquor evaporator unit.

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PROJECT DESCRIPTION

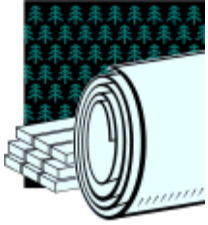
Goal: To acquire fundamental data on the chemical and physical behavior of Na_2CO_3 and Na_2SO_4 in kraft black liquor concentrators, and on the causes and control of soluble scale in high solids falling film concentrators.

The project will consist of both experimental and modeling efforts to clarify the process of soluble scale fouling. The solubility of sodium salts in high solids black liquor will be measured at various temperatures. Researchers will collect solubility data for kraft black liquor by equilibrating kraft black liquor and mixtures of black liquor with Na_2CO_3, Na_2SO_4, and NaOH, at a dry-solid content of 50 percent to 80 percent. They will also measure the rate of crystallization, particle size distribution, and factors that control deposition rate. Crystallization studies will be conducted using aqueous solutions of sodium carbonate and sodium sulfate in a batch evaporator-crystallizer, progressing to solutions of selected organic constituents, and finally, to black liquor. A model will be prepared to predict the rate of deposition of the sodium salts on the heat transfer surface of concentrators and tested in a pilot facility.

The general procedure will be to introduce a solution of Na_2CO_3 and Na_2SO_4 in a known ratio to the evaporator-crystallizer, apply heat at a constant rate until evaporation begins, collect concentrate to estimate the concentration of solutes remaining in the liquor, observe the beginning of nucleation (crystallization), continue the process until a designated concentration of Na_2CO_3 and Na_2SO_4 is achieved, and measure the fraction of solids recovered from the final slurry. This procedure will be repeated under variable experimental conditions to attain final solute concentrations of up to 80 percent by weight. Crystal structures in the solutes will be studied as a function of the experimental conditions.

PROGRESS & MILESTONES

- In year one, solubility data will be obtained from one kraft black liquor and from other liquors, crystallization experiments will be completed on inorganic model solutions, and a detailed computational flow model will be completed for the falling film evaporator.
- Also in year one, a pressurized pilot falling film evaporator facility will be constructed at IPST.
- In year two, all solubility data will be analyzed, crystallization experiments will be completed on one kraft black liquor, fouling-rate studies will be conducted on the pilot facility for building a model, and heat-transfer effects will be incorporated into a detailed computational flow model.
- Technical and economic evaluations of the instrumentation will also be performed in Phase III.
- In the third year, crystallization experiments on other kraft black liquors will be finished and the crystallization data analyzed and modeled.
- Also in the third year, the fouling-rate model will be finished, evaporation data will be obtained from the pilot facility to evaluate the fouling-rate data, and a detailed model for falling evaporator fouling will be completed and evaluated.
- Near the conclusion of this effort, pilot or full-scale trials will be proposed at a mill site where soluble scale is a problem in its high solids concentrators.
- A final milestone will be completion of a monograph on the causes and control of soluble scale



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